

# CS3133

## HW#7

DUE: Thursday, October 3

1. (7 points) Consider the CFG

$$G = (\{S, B, C, A\}, \{\text{if, then, else, while, do, } c_1, c_2, c_3, a_1, a_2, a_3\}, P, S)$$

with productions:

$$S \rightarrow \text{if } C \text{ then } A \mid \text{while } C \text{ do } A \mid B$$

$$B \rightarrow \text{if } C \text{ then } A \text{ else } S$$

$$C \rightarrow c_1 \mid c_2 \mid c_3$$

$$A \rightarrow a_1 \mid a_2 \mid a_3$$

Compute a CFG  $G'$  in Chomsky Normal form such that  $L(G) = L(G')$ .

2. (8 points) Use the PUMPING LEMMA for context free languages to show that

$\{ww^Rw \mid w \in \{0,1\}^*\}$  is not context free.

3. (2 points) Try to use the PUMPING LEMMA for context free languages to prove that  $L = \{abba, abracadabra\}$  is not context free. Show why your proof fails.

4. (8 points) Consider a context free grammar  $G = (V, T, P, S)$  in Chomsky Normal Form with no useless symbols.

a) Describe an algorithm to test if  $L(G) = \emptyset$ .

b) If there exists  $A \in V$  and a nontrivial derivation (a derivation of at least one step)

$A \Rightarrow^+ gAV$ ,  $g, V \in (V \cup T)^*$ , then can we conclude that  $L(G)$  **must** be infinite? Justify your response.